Analysis Report: Player Tracking and Re-Identification

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Objective

Defining the primary goal of this project as identifying, tracking, and re-identifying players within a single static video feed, particularly in a sports context. Aiming to extract valuable metrics including movement trajectories, speed estimates, presence heatmaps, and potential ball passes while maintaining consistent player identities across frames. This analysis supports sports analytics, tactical evaluations, and player performance assessments from monocular video sources.

Methodology

Initiating the pipeline with a custom-trained YOLOv8 model for detecting players and the ball in each frame. Feeding these detections into the DeepSort tracking algorithm to ensure consistent object identities. Utilizing a pretrained OSNet x1.0 model to generate appearance-based embeddings, enhancing robustness against ID switches and occlusions. Employing cosine similarity for comparing embeddings to re-identify players when necessary. Incorporating utility functions for proximity-based ball pass detection, speed calculation, and visualization outputs such as trajectory plots, heatmaps, and annotated videos using OpenCV.

Techniques

Applying key strategies including:

- Leveraging YOLOv8 for real-time object detection.

- Utilizing DeepSort for multi-object tracking.

- Generating visual embeddings for appearance-based re-identification with OSNet x1.0.

- Applying cosine similarity thresholding for player identity matching.

- Calculating displacement between frames for speed estimation.

- Implementing heuristic-based pass detection using ball proximity.

- Visualizing heatmaps and trajectories with OpenCV.

Integrating each component sequentially to build a reliable single-camera tracking and analysis system.

Results

Testing the system on a 15-second video revealed successful identification and tracking of multiple players. Demonstrating consistent ID assignment, cropped player image extraction, spatial presence heatmap generation, speed estimation in pixels per second, and ball pass detection based on distance thresholds. The output video (output.mp4) displayed all relevant overlays including IDs, speeds, and passes. This approach proves promising for sports video analytics, effectively capturing player movement and spatial density.

Challenges

Encountering the following issues during development:

- o ID switches occurring during rapid player movements or crowded scenes with over- laps.

- o Difficulty detecting the ball when occluded or appearing too small.

- o Potential limitations in embedding accuracy due to lack of sports-specific training data for OSNet.

- o Fixed distance thresholds for pass detection possibly unsuitable for varying camera setups or sports.

These challenges indicate needs for more adaptive reasoning or enhanced models for broader applicability.